

CRITICAL REVIEW WITH META ANALYSIS

## Are Islamic Banks Really Different from Conventional Banks? An Investigation using Classification Techniques

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### Keywords

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**Abstract.** This paper contributes to the empirical literature on Islamic finance by doing comparison of Islamic and conventional banks in Pakistan over the period 2005-2014. We apply both non-parametric and parametric classification methods (neural network, linear discriminant analysis, and logistic regression) to investigate whether financial ratios can be used to distinguish between Islamic and conventional banks. Univariate analysis reveals that Islamic banks are less profitable, better capitalized, more liquid, and have low level of credit risk as compared to their conventional counterparts. We also find that Islamic banks have more operating leverage in comparison to conventional banks. The results from classification techniques show that the two types of banks may be distinguished in terms of insolvency risk, credit risk, efficiency, and operating leverage, but not in terms of liquidity and profitability. More interestingly, we find that the financial crisis has a negative effect on the profitability of both Islamic and conventional banks. Lastly, the results show that the neural model obtained higher classification accuracies as compared to other models used in the study.

**KAUJIE Classification:** I2, L25, L3

**JEL Classification:** C44, C45, C25, G21, G28

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## INTRODUCTION

During the previous decade, conventional banking system has faced several financial difficulties mainly due to the 2007-2008 financial crisis. This crisis has not only affected the financial sector, but also the real economy very badly. Several banks simply failed to sustain their performance during the crisis (Belanes, Ftiti, & Regaieg, 2015). On the other

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hand, Islamic banks were in different situation as compared to conventional banks. The performance of Islamic banks was better during the 2007-2008 financial crisis (Hasan & Dridi, 2010). Many scholars have attributed this robust performance to the principles and rules of Islamic finance that prohibit interest and emphasize on financing activities backed by real assets based on the principle of sharing profit and loss (Beck, Demirgüç-Kunt, & Merrouche, 2010). Hence, after the financial crisis, Islamic banking system has received more attention of academics, investors, and policymakers. In recent years, Islamic finance, particularly Islamic banking, has been getting more success across the world.

Globally, there are more than 450 Islamic financial institutions that are operating throughout the world. These Islamic institutions include mortgage companies, insurance companies, mutual funds, and banks. Islamic windows have been introduced by many banks of western world, for instance, Citigroup, along with mainstream banking (Islam, Alam, & Hossain, 2014). This expansion of Islamic banking can be credited at a great extent to the two main factors. One of the fundamental factors is the need for banking without interest (*ribā*), which is a vital principle of Islamic finance, and secondly, the increasing demand for Sharī'ah-compliant products. For the purpose of diversification, investors of conventional banks have also shown their interest in Sharī'ah-compliant products. The Islamic banking industry has the ability to introduce and innovate products that fulfill the needs and demands of both Muslim and non-Muslim investors (Khediri, Charfeddine, & Youssef, 2015).

During the last three decades, due to the noticeable growth of Islamic banking, many Muslim and non-Muslim countries have shown their interest in Islamic banking. Countries like Sudan and Iran have only Islamic banking system. Further, there are countries like Pakistan and Malaysia where conventional banking yet is operating but they have also opened Islamic windows simultaneously, and few banks are working for conventional banking only. The increasing progress of Islamic banking is not confined to Muslim majority regions anymore. Rather, some Sharī'ah-compliant products are available even in the offices of the United States, Europe, and other areas.

Due to its unique principles, Islamic banking is different from conventional banking. The fundamental feature that differentiates the Islamic banking from the conventional banking is the prohibition of interest. Profit and Loss Sharing (PLS) and risk sharing principles are instrumental features, which differentiates conventional from Islamic banking. Finance providers do not transfer their risk to the users. Rather, they share profits and losses as well as the business risk. Islamic banking is different from conventional banking because in conventional banking the rate of return is fixed and risks are only borne by one party. Further, Islamic finance emphasizes on the principle that transactions are fully backed by real assets. Furthermore, there are many business related activities, which are not allowed in Islam, and they are not compliant with Islamic law. These activities include alcoholic products, gambling, entertainment (strip clubs etc.), and products related to pork.

The growing interest in Islamic banking and its ability to sustain financial crisis provide more scope to analyze whether conventional and Islamic banks behave differently or similarly before, during, and after the period of crises. In this paper, we investigate whether the two types of banks can be discriminated by using financial ratios. Most of previous studies

have compared both types of banking based on descriptive statistics. They have not distinguished between Islamic and conventional banks by using classification techniques. We employ quantitative and sophisticated techniques such as neural network, logistic regression, and linear discriminant analysis for differentiating Islamic and conventional banks. Our sample period includes the period of global financial crisis (2007-08), which allows us to find its effects.

The rest of the paper is structured as follows. The next section presents literature review and discusses the construction of hypotheses. The following section describes the methodology and data sources. The empirical results are given in Section 4. Finally, Section 5 concludes the paper.

## **LITERATURE REVIEW AND HYPOTHESES**

Several past studies have examined the determinants of the performance of banks in terms of efficiency and profitability. They have focused on the emergence of Islamic banks. Most of the studies explore external and internal factors that have an effect on the performance of conventional and Islamic banks. Metwally (1997) investigated the differences of financial characteristics of 15 conventional banks and 15 Islamic banks covering the period 1992-94. He found that the two categories of banks could be distinguished not only in terms of leverage, credit risk, and liquidity, but also in terms of efficiency and profitability. Iqbal (2001) using 12 conventional banks and 12 interest-free banks over the period 1990-98 analyzed that the interest-free banks were more capitalized and profitable as compared to the conventional banks. Olson and Zoubi (2008) investigated whether accounting ratios could be utilized to differentiate between Islamic and conventional banks operating in the region of GCC. Their analysis covered the period 2000-05. They found that two types of banking could be distinguished using non-linear techniques with the accuracy rate of 92%. Furthermore, their results showed that profitability level was higher in Islamic banks, but they had lower level of efficiency.

Beck et al. (2013) analyzed the difference between the features of Islamic and conventional banks using the data of 510 banks over the period 1995-2009 across 22 countries. They found that Islamic banks were more capitalized, less efficient, and had higher asset quality than conventional banks. During the 2007-2008 financial crisis, they found that Islamic banks had better performance in terms of asset quality and capitalization than the conventional banks. In another study, Abedifar, Molyneux, and Tarazi (2013) examined the stability feature and risk of Islamic banking system using data of 553 banks during the period 1999-09 from 24 countries. They found that, on average, Islamic banks were more profitable and capitalized as compared to their conventional counterparts.

Khediri et al. (2015) examined different aspects of risk, efficiency, and profitability of both Islamic and conventional banks for the period 2003-10 by using data of 18 Islamic and 44 conventional banks. Their results showed that Islamic banks had less credit risk, were more profitable, capitalized, and liquid as compared to their conventional peers. Moreover, by applying classification models, they found the significant difference between conventional and Islamic banking system.

Latif, Abbas, Akram, Manzoor, and Ahmad (2016) compared the level of performance of 5 interest-free banks and 5 conventional banks over the period 2006-10 in Pakistan by doing financial ratio analysis. They reported that conventional banks were bearing more risks, although both types of banking systems had been suffering from losses. Pappas, Ongena, Izzeldin, and Fuertes (2017) analyzed the riskiness of Islamic and conventional banks by using the data of 421 banks from Far and Middle Eastern countries. They indicated that Islamic banks have faced considerably less risk of failure as compared to their competitive peers.

Rashid, Khaleequzzaman, and Jabeen (2015) calculating the progress ratio of banks operating in Pakistan found that Islamic banks had better performance in year 2012 as compared to the year 2016. Rashid and Rehman (2016) measuring and decomposing the total factor productivity and efficiency of banks in Pakistan indicated that the total factor productivity of conventional banks was higher than that of Islamic banks. Rashid, Yousaf, and Khaleequzzaman (2017) examined the role of Islamic banks in the financial stability of financial sector of Pakistan. They found that compared to conventional banks, Islamic banks were better and more effectively contributing in the stability of financial sector.

The core focus of our study is to identify different financial ratios that are significant in differentiating conventional and Islamic banks. In this regard, we have developed four hypotheses. First hypothesis is based on the studies of Hassoune (2002), Khediri et al. (2015) and Olson and Zoubi (2008). It states that Islamic banks are more profitable as compared to conventional banks. Hassoune (2002) explained that the success can be attributed to the higher amount of non-interest bearing deposits and reliance of Islamic banks on their own funds. It is also noted that religious sentiments are important for Muslims. Due to their loyalty towards their religion, they always prefer Islamic banks for their deposits and financing. They are even willing to take relatively less returns from Islamic banks. Hence, the volatility level is less in the profits of Islamic banks as compared to their competitors. Another study of Abedifar et al. (2013) also stated that religious sentiments play an instrumental role in Islamic banks as customers tend to pay more attention to Islamic banks.

For profitability, two proxies namely Return on Assets (ROA) and Return on Equity (ROE) are used in this study based on the previous empirical literature (Iqbal, 2001; Olson & Zoubai, 2008). Based on the literature discussed above, we construct our first hypothesis as follows:

**H1:** Islamic banks are more profitable than conventional banks.

Our second hypothesis revolves around liquidity. Generally, banks may face the problem of liquidity due to excessive withdrawals from saving and current accounts. Cash ratios can measure the ability of bank to meet short-term obligations. Therefore, higher cash ratios are associated with less risk. Islamic banks cannot invest in prohibited business activities so they only invest in *halāl* activities. Islamic banks have limited access to the central bank and inter-bank market, which also challenges liquidity management. The previous empirical literature shows that the level of liquidity ratio is higher in Islamic banks as compared to conventional banks. For liquidity, the proxies we use in this study are the Cash to Asset Ratio (CTA) and the Cash to Deposit (CTD) ratio. These proxies have previously been used

by many studies in the literature (see, for example, Metwally, 1997; Olson & Zoubi, 2008). After reviewing the existing literature we have the following hypothesis:

**H2:** Islamic banks hold more liquid assets than conventional banks.

Our third hypothesis is about the efficiency of banks. The size of Islamic banking is expanding and the business of Islamic banks is growing rapidly but still conventional banks have more business opportunities and have a wider coverage. Rosly and Bakar (2003) examined that conventional banks are more efficient than Islamic banks. Another study by Yudistira (2003) provided evidence that in terms of cost efficiency, Islamic banks are still lagging behind their conventional counterparts. In this study, we use Operating Expenses to Asset Ratio (OEA) as the proxy for efficiency, which is also used by Olson and Zoubi (2008). Based on the argument given above we construct the following hypothesis.

**H3:** Islamic banks are less efficient than their conventional peers.

Our fourth hypothesis regarding the differences between Islamic and conventional banking focuses on insolvency and credit risk. These risks can harm any organization severely. The studies of Beck et al. (2013) and Olson and Zoubi (2008) provided evidence that Islamic banks have relatively lower level of credit risk.

The PLS principle allows Islamic banks to maintain their net worth and stabilize fluctuations in financial position under even tough economic circumstances. Under the mechanism of PLS, if losses occur on asset side, they can be absorbed on the liability side because returns and principle amounts are not guaranteed. Hence, risks are transferable from assets to liability side. In such way, if the value of asset decreases, then the liability side declines as well. Olson and Zoubi (2008) suggested that the minimization of credit risk is possible.

For credit risk, the common proxies used in the literature are Non-Performing Loans (NPL), the Loan to Deposit Ratio (LTD), and the Loan to Asset Ratio (LTA). For insolvency risk, the common proxies used in the literature are the Deposit to Equity Ratio (DTE), the Deposit to Asset Ratio (DTA), and the Equity to Asset Ratio (ETA). We also use these proxies in our analysis. They are frequently used in the literature (see, for instance, Beck et al., 2013; Bourkhis & Nabi, 2013; Khediri et al., 2015). We construct our forth hypothesis as follows.

**H4:** Islamic banks are less risky as compared to their conventional counterparts.

## DATA AND VARIABLES

To carry out the empirical analysis, we use annual dataset for the period 2005-2014. The sample of this research consists of 5 Islamic banks and 15 conventional banks operating in Pakistan. We exclude Islamic windows from the sample due to the non-availability of data. The full-fledge Islamic banks are Albarakah Bank, Dubai Islamic Bank, Meezan Bank, Burj Bank, and Bank Islami. The sample of conventional banks includes Silk Bank, Standard Chartered Bank, National Bank, Muslim Commercial Bank, JS Bank, Habib Bank, Faysal Bank, Bank of Khyber, Bank Alfalah, Bank Al Habib, Askari Bank, Allied Bank, Summit Bank, Soneri Bank, and United Bank. Data are retrieved from the financial statements of conventional and Islamic banks. Variable description is given in Table 1.

**TABLE 1**  
**Variable description**

Ratios	Denitions
<b>Protability</b>	
ROA	Return on assets = Net income/Total assets
ROE	Return on equity = Net income/Total stockholders' equity
<b>Liquidity</b>	
CTA	Cash to assets ratio = Cash & equivalents/Total assets
CTD	Cash to deposits ratio = Cash & equivalents /Total customer deposits
<b>Bank efficiency ratios</b>	
OEA	Operating expense over assets ratio = operating expense/average total assets
<b>Credit risk</b>	
NPL	Non-performing loans to gross loans ratio
LTA	Loans to assets ratio = Loans/Total assets
LTD	Loans to deposits ratio = Loans/Total customer deposits
<b>Insolvency risk</b>	
ETA	Equity to assets ratio = Total equity/Total assets
DTA	Deposits to assets ratio = Deposits/Total assets
DTE	Deposits to equity ratio = Deposits/Stockholder's equity
<b>Asset structure</b>	
FAA	Fixed assets over assets ratio = Fixed assets/Total assets
OBSIA	Off-balance sheet items over assets ratio = Off-balance sheet items/Total assets

### Univariate Analysis

The univariate analysis is to provide initial information on the differences between Islamic and conventional banks. Table 2 presents univariate statistics for the two categories of banks. Specifically, the table shows the mean of financial ratios for both banking systems covering overall period (2005-14). The table also reports the p-value of the mean equality test, which we apply to examine whether the mean value of the underlying financial ratios for Islamic banks is different from the corresponding values for conventional banks. We also divide our sample into pre and post financial crisis period to examine whether the difference between the mean values of the ratios is affected by the financial crisis of 2007-2008.

When we look the profitability of Islamic banks, we find that ROA and ROE have average mean value of -0.11% and 2.89%, respectively. However, the corresponding mean values for conventional banks are 1.68% and 10.89%, respectively. Thus, these figures indicate that Islamic banks are significantly less profitable as compared to their conventional peers. The p-value provides evidence that this difference is statistically significant at the usual level of significance. One possible reason for being less profitable of Islamic banks is that they are relatively young and small in size and thus, they may not be using their assets at the optimal level. On the other side, conventional banks are deep-rooted in the business and relatively

large. Thus, they may harvest the benefits of economies of scales and scopes in the one hand and on the other the hand; because of being old in the market, they have won the trust of the customers, which helps earn higher spread/margin.

**TABLE 2**  
**Univariate analysis for financial ratios**

Variables	Overall Period (2005-2014)			Pre/Crisis Period (2005-2008)			Post Crisis Period (2009-2014)		
	CB	IB	<i>p</i> -value	CB	IB	<i>p</i> -value	CB	IB	<i>p</i> -value
ROA	1.68	-0.11	0.004***	2.85	-0.07	0.059*	0.92	-0.12	0.004***
ROE	10.87	2.89	0.003***	16.8	2.52	0.020**	7.42	3.24	0.222
CTA	9.51	12.17	0.020***	10.85	15.05	1.145	8.82	11.73	0.004***
CTD	14.01	17.65	0.126	16.82	26.98	0.093*	12.46	14.7	0.222
NPL	9.07	3.09	0.000***	6.08	0.79	0.000***	10.96	4.29	0.000***
LTA	7.78	6.73	0.606	5.66	10.87	0.342	9.13	5.39	0.59*
LTD	11.78	10.65	0.772	8.91	14.01	0.533	13.63	9.90	0.436
DTA	73.91	71.60	0.518	74.87	60.16	0.039**	74.16	81.33	0.000***
DTE	965.9	692.6	0.020**	910.4	411.2	0.001***	1009.8	860.9	0.131
ETA	11.30	16.95	0.043**	15.01	24.12	0.119	9.20	14.97	0.067*
OEA	1.19	3.14	0.000***	1.15	2.75	0.028**	1.22	3.53	0.000***
FAA	12.77	51.77	0.022**	10.48	32.40	0.059*	14.29	63.55	0.049**
OBSIA	28.04	27.09	0.830	30.40	44.02	0.198	26.94	21.55	0.201

Note: The mean values of the selected financial ratios are reported in this table. CB represents conventional banks and IB represents Islamic banks. The table also reports the *p*-value for the *t*-test to test the equality of mean between the two types of banks.

\*Significance at the 10% level.

\*\*Significance at the 5% level.

\*\*\*Significance at the 1% level.

When we compare the mean value of both profitability ratios for pre and post financial crisis periods, we observe that although the mean value of ROA for conventional banks is higher than that of Islamic banks, Islamic banks appear more profitable in terms of ROE in the post financial crisis period. Yet, this difference is not statistically significant at the acceptable level of significance. This finding suggests that because of showing strong resilience during the financial crisis of 2007-2008, Islamic banks have attracted more business and attained the trust of customers, which, in turn, results in higher profitability.

The mean of the liquidity ratio, the CTA, is 12.17% for Islamic banks, whereas, the corresponding figure for conventional banks is 9.51%. The mean difference of CTA appears statistically significant. Similarly, for both pre and post financial crisis periods, the mean of CTA is greater for Islamic banks than conventional banks, the difference, however, is statistically significant only in post financial crisis period. Comparing the mean value of the CTD, we find that although the mean value for Islamic is greater than that of conventional banks, the difference is not statistically different from zero. Taken together, the liquidity ratios suggest that Islamic banks hold more cash in their hands as compared to their conventional counterparts. One possible reason for Islamic banks having more cash in their reserves is that they may be unable to find appropriate, profitable Sharī'ah-complaint investment opportunities. This suggests a dire need of well-developed and well-functioning

Islamic capital market, which would enable Islamic banks to invest excess liquidity in long-term assets.

We use three different ratios to gauge credit risks. These ratios are NPL, LTA, and LTD. The NPL ratio has the mean value of 3.09% for Islamic banks and 9.07% for conventional banks. The mean difference of this ratio is statistically significant at the 1% level. This finding indicates that conventional banks on average have more credit risk as compared to Islamic banks. This significant difference between conventional and Islamic banks also holds for pre and post financial crisis period. The difference in mean values of other two ratios does not appear statistically significant.

Another noticeable difference between the two types of banks is in terms of the efficiency ratio. The mean value of the OEA is 3.14% for Islamic banks and 1.19% for conventional, indicating that Islamic banks are less efficient on average as compared to conventional banks. This observation is consistent with the literature; showing Islamic banks are relatively less efficient in terms of operating assets and managing expenses. This difference remains significant in pre and post financial crisis periods.

With regard to insolvency, the mean value of the ETA and the DTE for Islamic banks is 16.95% and 692.6%, respectively. The corresponding figures are 11.30% and 965.9% for conventional banks, respectively. The mean difference of these two ratios for Islamic and conventional banks is statistically significant at the 5% level of significance. These results show that compared to conventional banks, Islamic banks face higher risk. The statistics given in the table also provide evidence that both types of banks have quite different asset structure as well. However, we do not find any significant difference in the mean values of the remaining underlying ratios for Islamic and conventional banks.

Table 2 also presents means of financial ratios of Islamic and conventional banks for the period pre financial crisis (2005-08) as well as for post financial crisis period (2009-14). We observe that most of the mean values and the difference for Islamic and conventional banks are similar to the full sample period (2005-14), indicating that the Islamic banks in Pakistan are less profitable, less risky, more liquid, and have more operating leverage. However, there are some prominent differences across two sample periods. For example, the mean value of DTA is higher for conventional banks during the pre financial crisis period, whereas, it becomes vice versa during the post financial crisis period. Similarly, during the pre financial crisis period, the mean value of OBSIA is higher for Islamic banks, whereas, it becomes the reverse during the post financial crisis period.

## PARAMETRIC AND NON-PARAMETRIC TECHNIQUES

We apply both parametric and non-parametric methods to identify the financial ratios that are significant in distinguishing Islamic and conventional banks operating in Pakistan. Below we explain both types of methods.

### Parametric Methods

Linear Discriminant Analysis (LDA) and logistic regression are statistical techniques, which are widely used to analyze the data and different variables with categorical outcome. Linear

discriminant analysis is highly useful to identify the variables that are useful for the differentiation between the two underlying groups, in our case Islamic and conventional banks. This method only ascertains the most significant variables from a large set of variables that have potential to differentiate the two groups. However, the performance of this method is critically based on the underlying assumptions such as normality of the data, large sample size, and homogeneity of variance-covariance matrix. Logistic regression is also useful in many ways. The purpose of logistic model is to search the best model, which can describe the relationship of independent variables with outcome. Logistic models are more flexible as compared to linear discriminant analysis. In case when the data do not fulfill the required assumptions of linear discriminant analysis, logistic models provide more reliable and robust results. Therefore, we apply both techniques.

### ***Linear discriminant analysis***

LDA is a multivariate method. It facilitates the researchers to find out linear combinations that differentiate between different classes of events. In our research, it is used to differentiate the performance of Islamic banks from that of the conventional banks. This technique is usually used for classification of samples of different classes that are not known (Fisher, 1936). Discriminant function is described in our case as follows.

$$Z = \alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + \epsilon \quad (1)$$

The discriminant coefficients are  $\beta_1, \beta_2, \dots, \beta_n$ , the input variables are  $x_1, x_2, \dots, x_n$ , and  $\alpha$  is a constant term.  $Z$  is an overall index. The discriminant coefficients enable scholars to differentiate the classes based on the identified variables/factors.  $\epsilon$  is the error term. To perform the analysis, we assign value '1' to conventional banks and value '2' to Islamic banks.

Among the thirteen financial ratios used in the analysis, the linear discriminant analysis technique would select the more important and significant variables in order to discriminate between the two types of banks. Furthermore, it will provide the Chi-square, the Wilk's Lambda, and the accuracy rate of classifications. The results given in Table 3 show that out of thirteen financial ratios, only four ratios, namely DTA, NPL, OEA, and FAA are selected by linear discriminant analysis for the period 2005-2014 by using the data of Islamic and conventional banks. The significant and negative coefficient of the DTA shows that the reliance of Islamic banks on deposits is less as compared to conventional banks. The negative coefficient of the ratio of NPL indicates that Islamic banks face less credit risk. The positive and significant coefficient of FAA ratio reveals that fixed assets are more in Islamic banks and they also have higher operating leverage than conventional banks. The positive coefficient of the OEA provides evidence that Islamic banks are less efficient. These results are statistically significant at the 1% level. The hit rate is 86.2%. The results suggest that these identified ratios can be used to differentiate Islamic and conventional banks. The results of diagnostic tests indicate the reliability of the estimation results of the linear discriminant analysis.

**TABLE 3**  
**Results of linear discriminant analysis**

Variables	Overall Period (2005-2014)	Pre Crisis Period (2005-2008)	Post Crisis Period (2009-2014)
NPL	-0.638*** (0.000)	-0.567*** (0.000)	-0.655*** (0.000)
DTA	-0.327*** (0.000)		0.280*** (0.000)
OEA	0.521*** (0.000)		0.498*** (0.000)
FAA	0.700*** (0.000)	0.893*** (0.000)	0.688*** (0.000)
Canonical Correlation	0.616	0.718	0.671
Wilks' Lambda	0.621	0.651	0.550
Chi Square	89.172	25.723	69.401
<i>p</i> -value	0.000	0.000	0.000
Hit rate (%)	86.2%	87.3%	82.5%
No. Obs.	192	72	120

Note: This table shows the results of linear discriminant analysis. *p*-values are reported in parentheses.

\*\*\* Significance at the 1% level.

We redo the linear discriminant analysis for pre and post financial crisis periods with an aim to examine whether financial crisis affected the differential characteristics of Islamic and conventional banks. The results given in Table 2 indicate that only two ratios (NPL and FAA) discriminate between two categories of banking system for the pre financial crisis period (2005-08) with the hit rate of 87.3%. However, we find that similar to the case of full sample, for the post financial crisis period (2009-2014), four ratios, viz. NPL, DTA, FAA and OEA, are significant in differentiating Islamic and conventional banks. The hit rate is 82.5%. These findings suggest that Islamic banks are distinguishable from their conventional counterparts in terms of only two ratios before the recent financial crisis. Yet, after the financial crisis periods, they can be discriminated on the basis of four ratios identified in the analysis. The statistics of diagnostic tests confirm the robustness of the estimation results.

### ***Logistic regression***

In this approach, it is assumed that the probability of an outcome is dichotomous and it presents predictor variables in the following way:

$$\log\left(\frac{P}{1-P}\right) = \alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + \epsilon \quad (2)$$

where *p* shows the probability of an interested outcome,  $\alpha$  denotes the intercept,  $\beta_1$  show the coefficients, and represents the error term. The dependent variable consists of logarithm

of possibilities of outcome of interest and they are categorical variables. Selection of the variables for perfect fitted model is based the stepwise technique, specifically, either backward or forward techniques of regression (Neter, Kutner, Nachtsheim, & Wasserman, 1996; Pampel, 2000).

Forward selection of variables involves the procedure of adding only a single variable at first in the model, then adding one-by-one variable in each step that results in the improvement of model and getting significant results. While backward elimination includes all the variables at the beginning, then with each step deletion of the variables starts, and it continues until we get the perfect model. If the value of  $(\frac{p}{1-p})$  is 0 then it is considered a representation for conventional banks, whereas, 1 represents the Islamic banks (Olson & Zoubi, 2008). In this way, the banks which are Islamic can be differentiated from the banks that are conventional.

The results of logistic regression are reported in Table 4. By using backward stepwise regression procedure, out of thirteen predictors/variables, only three variables are statistically significant and significantly discriminate between Islamic and conventional banks for the period 2005-14. These three variables are the OEA, the Fixed Assets to Total Assets ratio (FAA), and the NPL. The positive coefficient on OEA depicts that Islamic banks lack efficiency in comparison to their conventional counterparts. The positive coefficient of FAA suggests that Islamic banks have higher operating leverage. The variable non-performing loans ratio appears with a negative coefficient, indicating the fact that Islamic banks are less risky as compared to conventional banks. We get similar results by re-estimating the logistic regression for the pre financial crisis period (2005-2008), but now only two predictors are significant at the acceptable level of significance. Specifically, we find that NPL and OEA are statistically significant to differentiate between the two banking systems. However, for the post financial crisis period (2009-2014), FAA, NPL, and OEA appear significant ratios for differentiating the two types of banking. The hit rate that indicates the success rate of the model for overall period is 83.3%. For the pre and post financial crisis periods, the hit ratio is 84.7% and 86.7%, respectively. These hit rates provide strong evidence of the soundness of the results of the analysis.

**TABLE 4**  
**Logit model results**

Variables	Overall Period (2005-2014)	Pre Crisis Period (2005-2008)	Post Crisis Period (2009-2014)
FAA	0.389*** (0.000)		0.526*** (0.002)
NPL	-4.148*** (0.000)	-6.601** (0.03)	-4.499*** (0.000)

Notes: This table reports the results from stepwise logit model.

*p*-values are in the parentheses.

\*\*\* Significance at the 1% level.

\*\* Significance at the 5% level.

**Table 4**  
**Continue....**

Variables	Overall Period (2005-2014)	Pre Crisis Period (2005-2008)	Post Crisis Period (2009-2014)
OEA	5.905*** (0.000)	7.194*** (0.01)	8.407*** (0.002)
Constant	-0.113 (0.009)	0.159 (0.114)	-1.476 (0.111)
Chi Square	97.880	39.572	94.848
<i>p</i> -value	0.000	0.000	0.000
<i>R</i> squared	0.399	0.423	0.546
Hit rate (%)	83.3%	84.7%	86.7%
No. Obs	192	72	120

Notes: This table reports the results from stepwise logit model.

*p*-values are in the parentheses.

\*\*\* Significance at the 1% level.

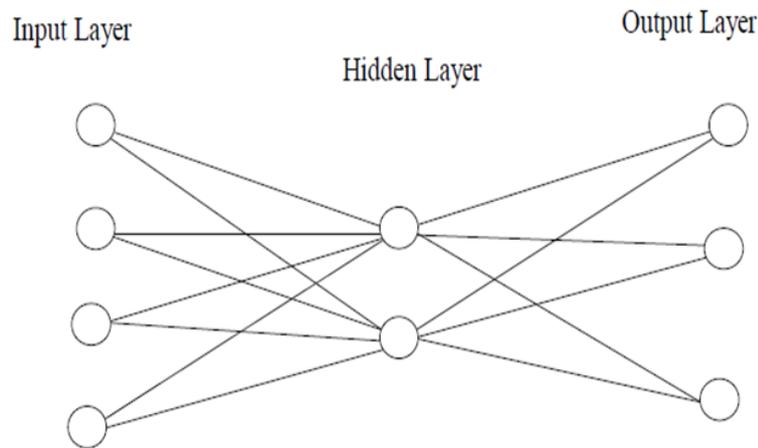
\*\* Significance at the 5% level.

### Non-Parametric Technique

We also apply non-parametric method to differentiate between Islamic and conventional banks. This method uses predictor variables in a hierarchical manner. To get high success rate of classification, parametric methods assume the normality of observation, large sample size, no outliers, and the homogeneity of variance-covariance matrix (Rubin, 1990). If these hypotheses are not fulfilled, then non-parametric techniques become more efficient as compared to parametric methods. Therefore, we also apply non-parametric method to ensure the robustness of our results.

### Neural model

Neural models have been frequently used in the past researches (Kuhn & Johnson, 2013). Neural network is a part of non-parametric methods. It is basically an algorithmic technique that mainly converts inputs into output using networks, which are interconnected with simple processing. Nodes are the significant and essential elements of the neural model. The connection of nodes with each other can be analyzed by the architecture of neural network. These nodes are connected in a certain way. The node that provides outcome can be utilized as an input for other nodes. By using some specific functions the input of the nodes can be transferred into an output. All these nodes are connected in different kinds of layers. An input layer basically receives inputs, but, on the other hand, the final layer receives the output signal, which is called output layer. Hidden layer can be found between input and output layers (Khediri et al., 2015). In this method, the financial ratios would be ranked as per their strength in order to differentiate between Islamic and conventional banks.



**FIGURE 1.** Gradient of the objective function

Table 5 presents both normalized and simple importance of the thirteen financial variables used in the neural model for three periods 2005-14, 2005-08, and 2009-14. Independent variables' importance measures how much the predicted value of the network for different values of independent variable is important. The normalized importance indicates the relative strength of the underlying ratio and is defined as the importance of the financial ratio in the neural network divided by the highest importance value and multiplied by 100. Neural model also provides hit rate to examine the overall accuracy of the analysis.

For the whole sample period 2005-14, the results indicate that the FAA ratio obtained that highest importance followed by NPL, OEA, and DTA, respectively. It shows that the FAA ratio plays the most significant role in the prediction. This finding also suggests that the FAA ratio is more important than the other considered ratios for differentiating Islamic and conventional banks operating in Pakistan. On the other hand, ROE appears with its lowest value, suggesting that it has no influence on the prediction. This finding suggests that both Islamic and conventional banks are similar in terms of ROE. This finding is opposite to what we observed through summary statistics. The hit rate is 86.9%, ensuring the robustness of the analysis.

As it can be seen from the table, for the pre financial crisis period 2005-08, OEA has the highest influence on the predictability of model followed by NPL, OBSIA, ROE, and ROA, respectively. The ratios NPL and OEA support the results of LDA and logistic regression. The LTA has the lowest significance value. The accuracy rate is 94.1%. For the period 2009-14, the FAA ratio has the maximum influence on the model while the OBSIA ratio is unable to predict the neural model. The accuracy rate for this period is 90%. In sum, the results presented in Table 4 suggest the relative strength of the financial ratios in differentiating Islamic and conventional banks. The results given in the table also indicate that the relative importance of the ratios for distinguishing the two types of banking was different in pre and post financial crisis periods.

**TABLE 5**  
**Results of neural model**

Variables	Overall Period (2005-2014)		Pre-Crisis Period (2005-2008)		Pre-Crisis Period (2005-2008)	
	Importance	Normalized Importance (%)	Importance	Normalized Importance (%)	Importance	Normalized Importance (%)
ROA	0.047	30.5%	0.093	66.6%	0.075	56.6%
ROE	0.039	25.2%	0.102	73.0%	0.042	31.7%
CTA	0.075	49.1%	0.059	42.6%	0.057	42.8%
CTD	0.066	43.2%	0.043	30.6%	0.056	42.6%
LTD	0.074	48.0%	0.053	38.1%	0.072	54.6%
LTA	0.063	40.8%	0.031	21.9%	0.103	77.9%
NPL	0.115	74.7%	0.119	85.7%	0.099	74.6%
OEA	0.102	66.5%	0.139	100%	0.127	95.9%
DTA	0.082	53.6%	0.101	72.3%	0.117	88.5%
ETA	0.068	44.3%	0.044	31.9%	0.056	42.4%
DTE	0.068	44.1%	0.036	26.0%	0.041	31.1%
FAA	0.154	100%	0.067	48.2%	0.132	100%
OBSIA	0.048	31.1%	0.113	80.9%	0.023	17.2%
Hit rate (%)	86.9%		94.1%		90%	

Note: This table provides the classification neural model results, specially the importance and normalized importance for independent variables.

## CONCLUSIONS AND POLICY IMPLICATIONS

This paper aims to identify the ratios that significantly differentiate Islamic banks from conventional banks. For this purpose, we perform univariate analysis and apply both parametric and non-parametric approaches by considering several important ratios over the period 2005-2014. The paper provides several fascinating findings. Firstly, it is noted that conventional and Islamic banks have quite different behavior during different circumstances. The summary statistics suggest that in terms of profitability, Islamic banks are significantly lacking behind from conventional banks. It is also observed that conventional banks are generally more efficient as compared to Islamic banks. However, the level of risk is significantly less in Islamic banks as compared to their conventional counterparts. The statistics also reveal that compared to conventional banks, Islamic banks are also more liquid on average. Secondly, it is clear that by applying the classification techniques i.e., non-parametric and parametric models, the two categories of banks can quite definitely be differentiated on the basis of identified financial ratios. Classification techniques suggest that fixed assets, operating expenses, credit risk, and insolvency risk are significant in distinguishing Islamic and conventional banking, while profitability and liquidity ratios do not differentiate Islamic banks from the conventional banks.

The findings of the paper are of significant to policymakers in order to introduce and implement certain measures for banking sector in Pakistan since this research differentiates both categories of banks. The findings are also useful for investors, depositors, customers, and bank managers to understand the financial characteristics that are significant to distinguish the Islamic banks from the conventional banks. The results also suggest that

managements of Islamic banks should take serious steps to enhance the profitability of Islamic banks to compete with their conventional counterparts. Further, Islamic banks should manage liquidity effectively, ensuring that it neither intensifies the risk of solvency, nor adversely affects the profitability of banks. Both profitability and efficiency of the financial sector can also be improved, particularly during periods of financial and economic unrest, if more attention is given to Islamic banking.

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